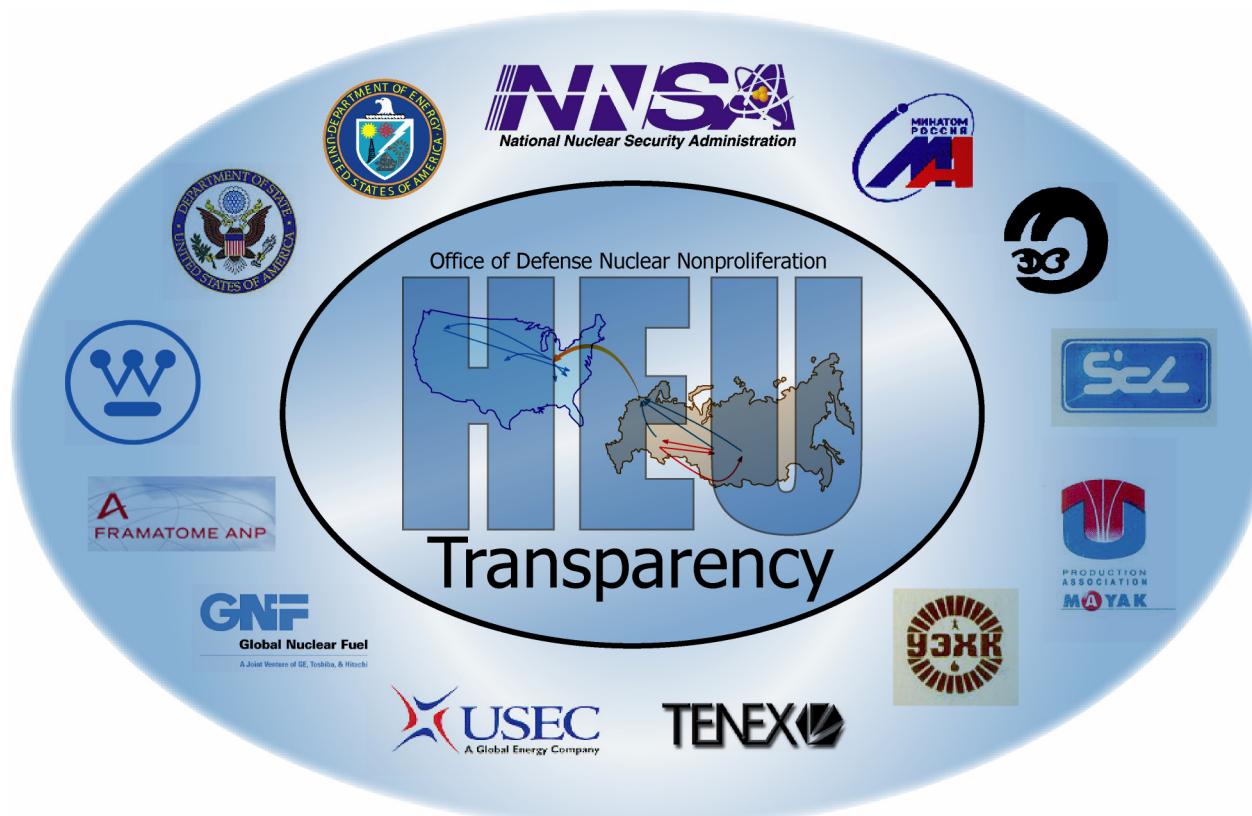


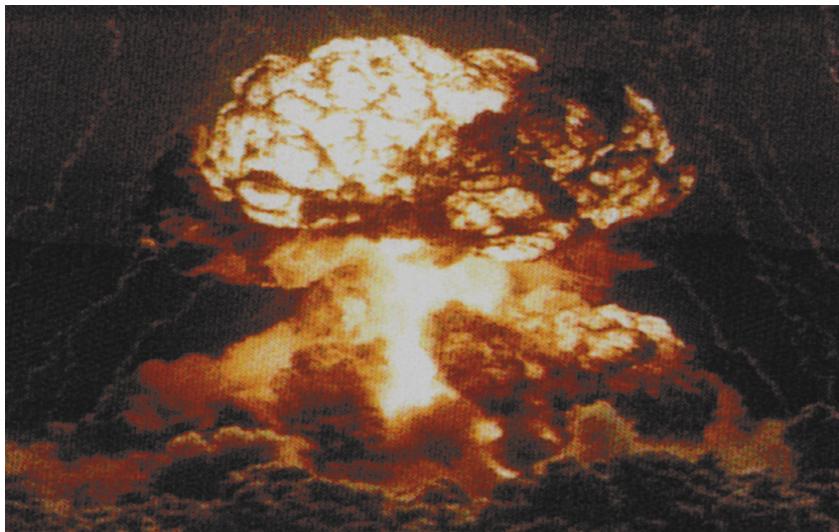
# Highly Enriched Uranium Transparency Program



Office of Dismantlement and Transparency

# The United States-Russian Intergovernmental HEU-LEU Agreement

*In 1993 the United States agreed to purchase 500 metric tons of HEU from dismantled Russian nuclear weapons, in the form of 15,000 metric tons of LEU, for approximately \$12 billion over 20 years.*



“Megatons” are being converted to.....



.....“Megawatts” under the U.S.-Russian  
Intergovernmental HEU-LEU Agreement

*This Agreement provides LEU for fabrication into power reactor fuel, with equivalent energy to meet all U.S. electricity demand for two years. The Agreement's transparency measures assure that the nonproliferation objectives of this Agreement are met, including provisions for nuclear material accounting and control.*

# Evolution of the HEU-LEU Agreement

**August 31, 1992:** President Bush (pictured with President Yeltsin) announced that the United States and the Russian Federation have negotiated and initialed the HEU Purchase Agreement



**March 18, 1994:** Vice-President Gore and Russian Prime Minister Chernomyrdin sign Protocol on HEU Transparency Arrangements in Washington, D.C.



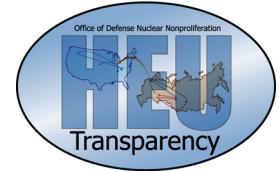
**June 30, 1995:** Energy Secretary O'Leary and Russian Minister Mikhailov sign Joint Statement on Transparency Arrangements in Moscow

# Transparency Overview



- Transparency is those agreed upon measures used to build confidence that the arms control and nonproliferation objectives of the 1993 United States - Russian Highly Enriched Uranium (HEU) Agreement are being met.
- The goal of the HEU Transparency Program (TP) is to support United States (U.S.) nonproliferation policy by providing confidence that Russian low enriched uranium (LEU) sold to the United States is derived from HEU removed from dismantled Russian nuclear weapons.
- The Program benefits United States nonproliferation policy by assuring the permanent removal of 500 metric tons of weapons-grade HEU in Russia, equivalent to about 20,000 nuclear weapons.

# Highly Enriched Uranium Transparency Program



- Transparency measures are to assure that:

*HEU is from Russian weapons-usable material.*



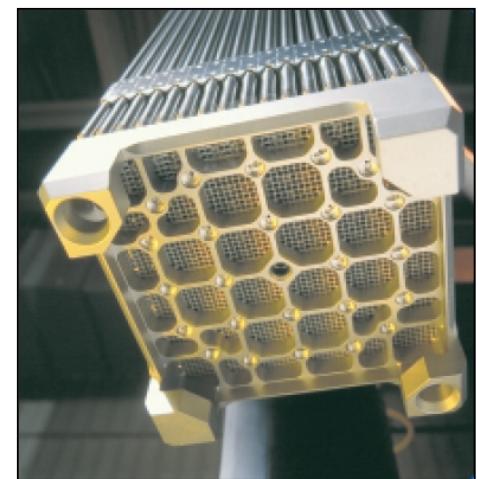
Tactical nuclear device being loaded

*This same HEU is converted and downblended to LEU.*



HEU-TP monitor at a Russian facility glove box that is used to burn uranium metal and produce uranium oxide

*The LEU shipped to the United States is fabricated into fuel for commercial nuclear reactors.*



Nuclear fuel rod assembly

- We have full access to four Russian plants per the Agreement.
- Accomplished over ten years of transparency monitoring activity.
- Provide support to US nonproliferation policy initiatives.

# Transparency Chronology



September 1994

- The United States held the first HEU transparency discussions with Russia in March 1993.
- In May 1993, a U.S. delegation conducted the first visit to a Russian processing facility where HEU will be blended down into LEU.



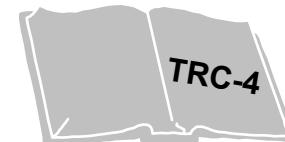
July 1995

- In June 1993, a Russian delegation conducted its first visit to the Portsmouth, Ohio Enrichment Plant and to a U.S. fuel fabricator.
- Memorandum of Understanding (MOU) related to Transparency signed in September 1993.
- Protocol to the MOU signed in March 1994. It provides additional details on transparency rights and establishes the U.S./Russian Transparency Review Committee (TRC).



November 1995

- The second TRC signs Annexes 1 & 2. Each annex provides specific detail on implementing monitoring rights for each country.
- On June 23, 1995, the first shipment of LEU converted from weapons HEU arrives at the Portsmouth, Ohio enrichment plant.



April 1996



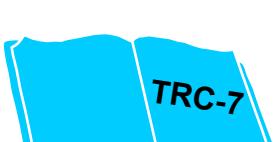
December 1996



November 1997



February 1998



July 1999



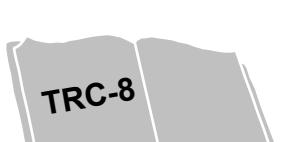
April 2004



August 2003

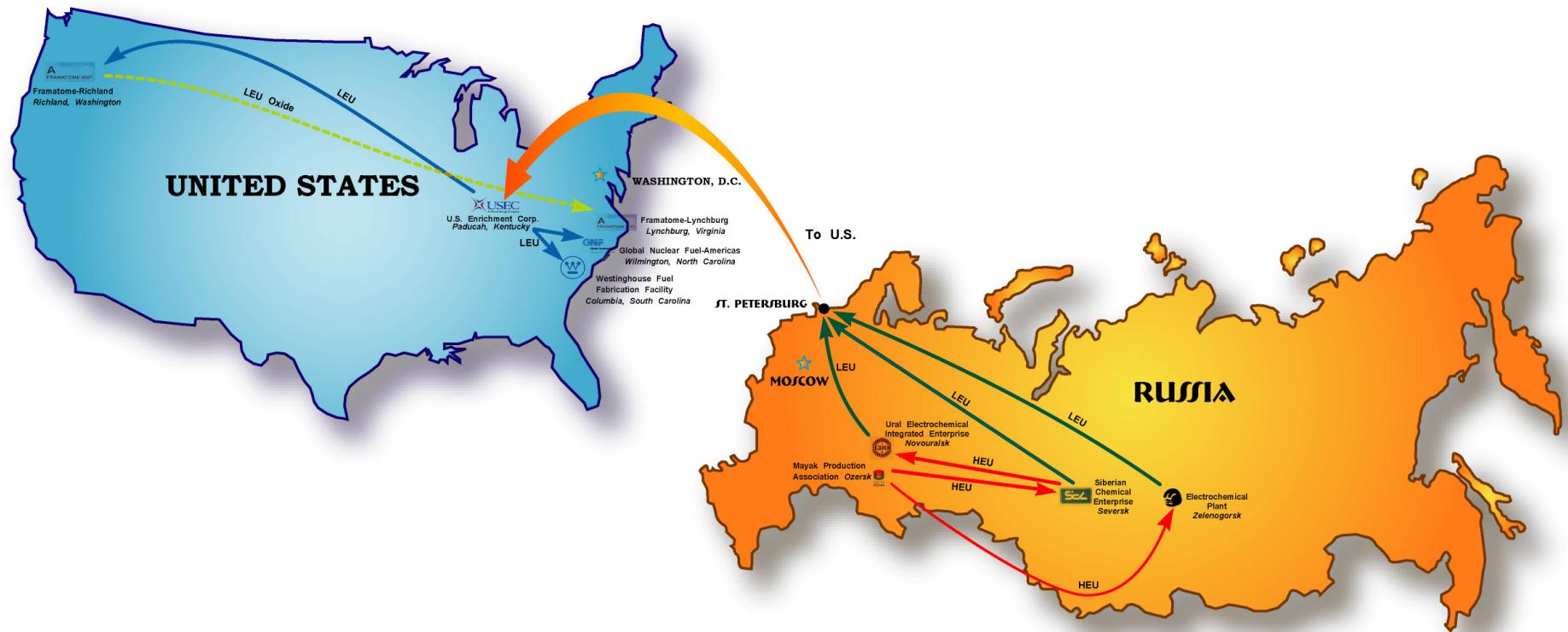


November 2002



July 2001

# Facilities Subject to the Agreement



**Arrows Indicate the Flow of Material**  
**Red is HEU    Gold / Blue is LEU**

# Russian Facilities and Processes



**Two Russian facilities receive HEU weapons components from dismantled Russian nuclear weapons**

**Siberian Chemical Enterprise (SChE) in Seversk**



*HEU-TP monitors inspect weapons component transport containers at MPA*



**Mayak Production Association (MPA) in Ozersk**

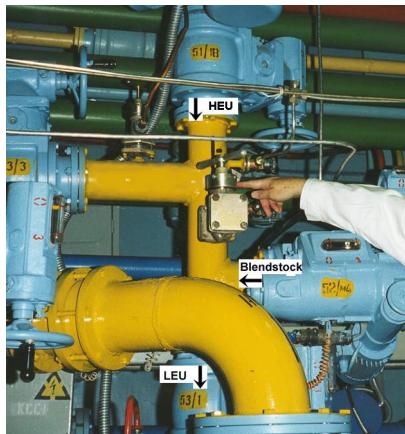


*HEU-TP monitors inspect HEU oxide containers at SChE*

# Russian Facilities and Processes



**Three Russian facilities convert and blend down HEU to LEU for shipment to the United States**



*Blend point at SChE*



**Siberian Chemical Enterprise**



*LEU cylinder filling station at ECP*

- Receive HEU oxide
- Convert oxide to  $\text{UF}_6$
- Down blend HEU into LEU
- Ship LEU to USEC

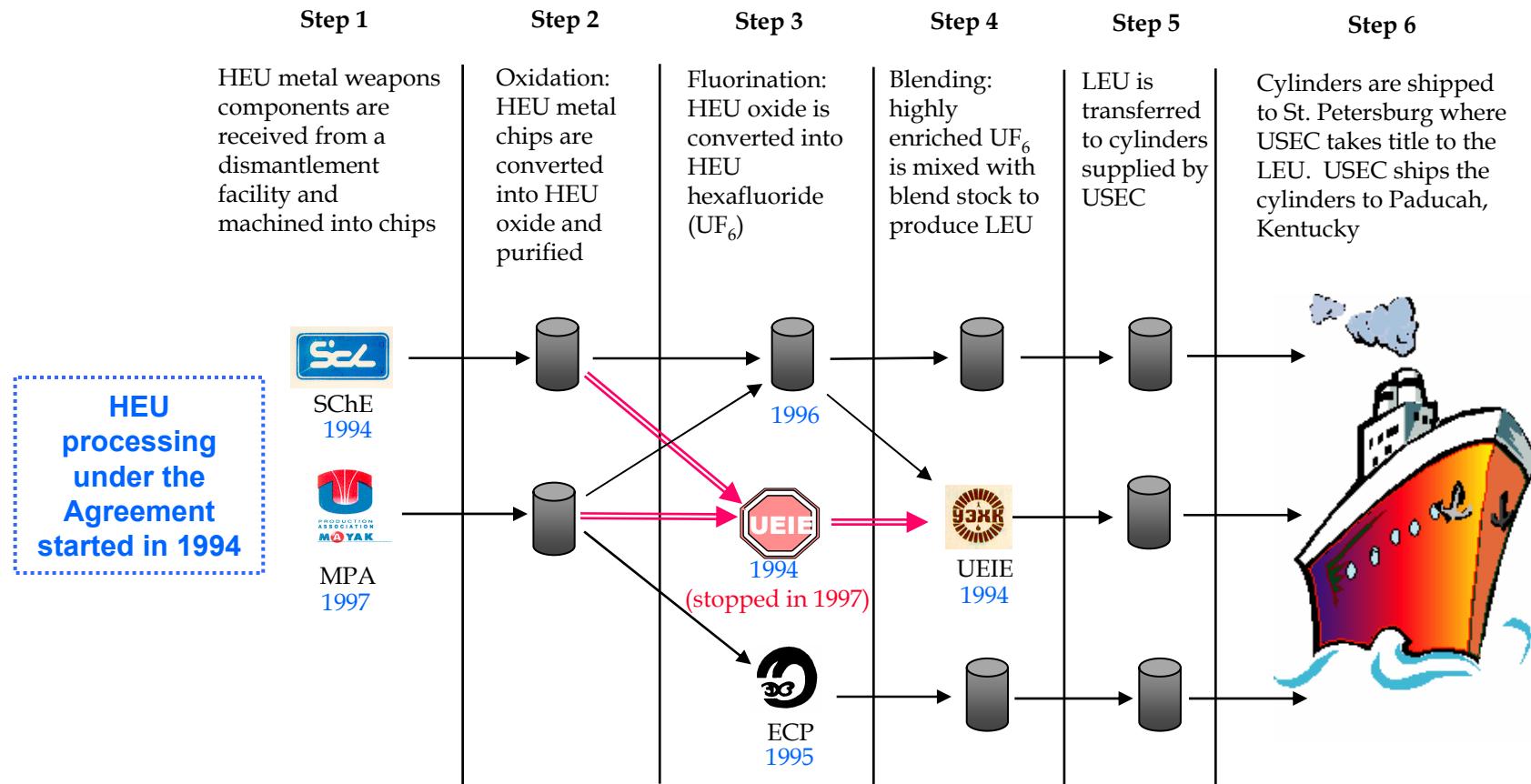
**Ural Electrochemical Integrated Enterprise (UEIE) in Novouralsk**



*Uranium hexafluoride transfer station at UEIE*



# Transparency Program: Monitoring the Conversion of HEU Weapons Components to LEU



USEC - United States Enrichment Corporation

MPA - Mayak Production Association, Ozersk

UEIE - Ural Electrochemical Integrated Enterprise, Novouralsk

ECP - Electrochemical Plant, Zelenogorsk

SChE - Siberian Chemical Enterprise, Seversk

# Process Facilities in the United States



**Paducah Gaseous Diffusion Plant receives all LEU shipped from Russia.**



**Last Russian Monitoring visit to the United States was in October 2005.**

*Russian monitors at the Paducah Gaseous Diffusion Plant observe NDA test on LEU cylinder from Russia*



10/02/2005



**Five U.S. fuel fabricators subject to monitoring by Russian Federation:**

- **Global Nuclear Fuel-Americas, Wilmington, NC**
- **Framatome-Lynchburg, Lynchburg, VA**
- **Framatome-Richland, Richland, WA**
- **Westinghouse Nuclear Fuel, Columbia, SC**
- **Westinghouse-Hematite\*, Hematite, MO**

*US and Russian monitors at Global Nuclear Fuel-Americas*



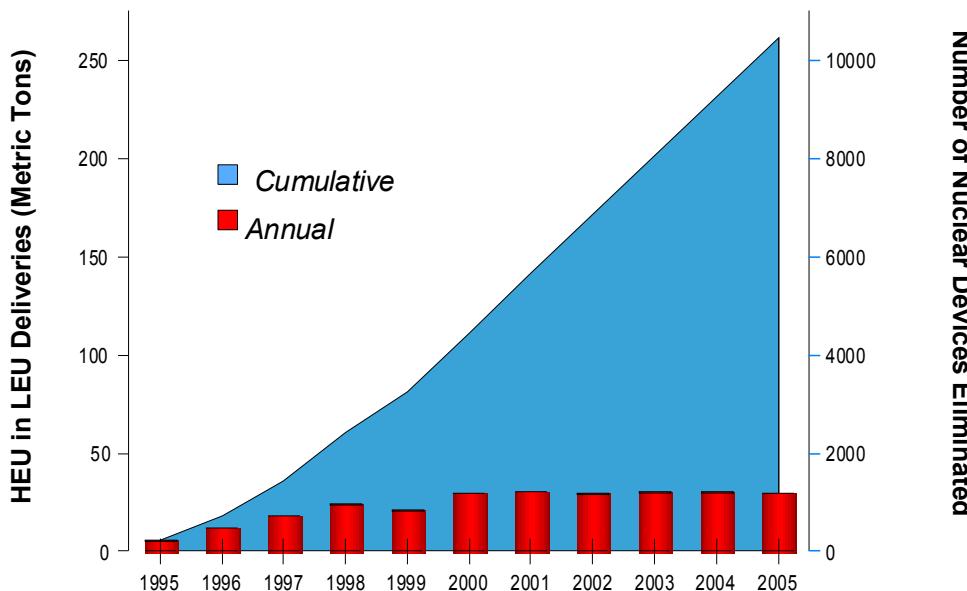
*US and Russian monitors at the Framatome-Richland Plant*

\* Ceased fabrication operations in 2001.

# Program Milestone: 50% of the HEU Has Been Eliminated



## Weapons-usable HEU Eliminated



**30 MT HEU Annual Conversion Rate (2000-2013)**

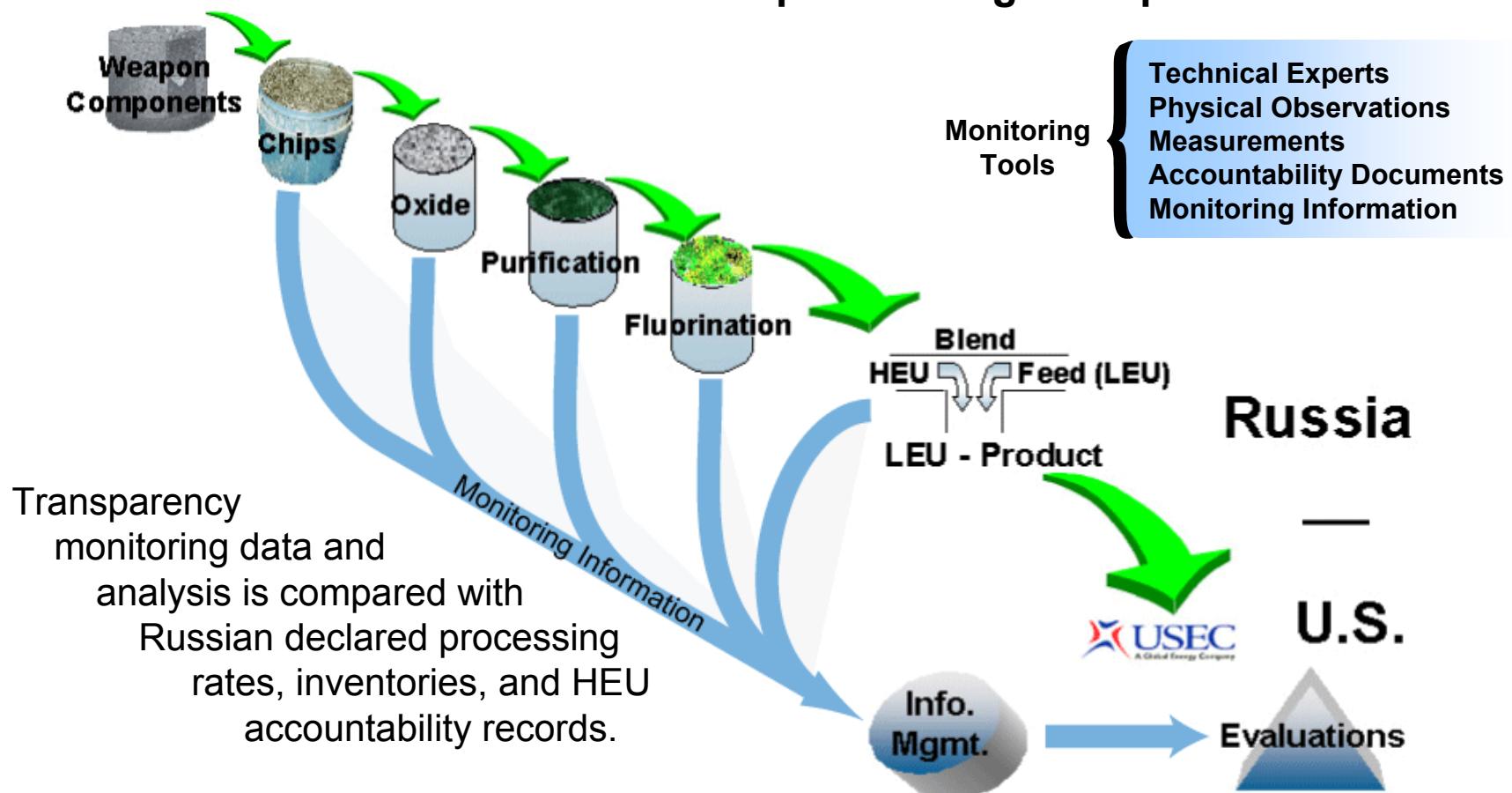
- Through December 2005, HEU-TP has monitored the conversion and blending of 261.7 metric tons (MT) of HEU used to produce the LEU delivered to US Enrichment Corporation.
- 261.7 MT of HEU is equivalent to 10,467 nuclear devices\*.
- Russia has delivered a total of 7670 MT of LEU containing 48.1 million SWU and 78.7 thousand MT of natural uranium.
- Conversion of 500 MT HEU into 15,000 MT of LEU should be completed in 2013 under the 20-year contract.
- 500 MT of HEU is roughly equivalent to 20,000 nuclear devices\*.

\* Per IAEA standard for significant quantity of nuclear material

# HEU Transparency Information Process



**Monitors gather data on material processing rates and material containers in Russian plant storage and process areas.**



# HEU-TP Monitoring Activities to Assure Nonproliferation Objectives are Met



Monitors annually conduct up to 24 Special Monitoring Visits to Russian uranium processing plants and staff a Transparency Monitoring Office (TMO) at UEIE to gather data on material processing rates and material containers in storage areas.

Portable Nondestructive Assay (NDA)  
Instrumentation is used to determine assay of HEU in Russian containers.



Monitor uses NDA equipment at Russian plant



Monitors in uranium hexafluoride storage facility at SChE

The U.S. designed Blend Down Monitoring System (BDMS) confirms the traceability, flow and enrichment assay of HEU being blended into LEU. The BDMS was installed at UEIE in January 1999.

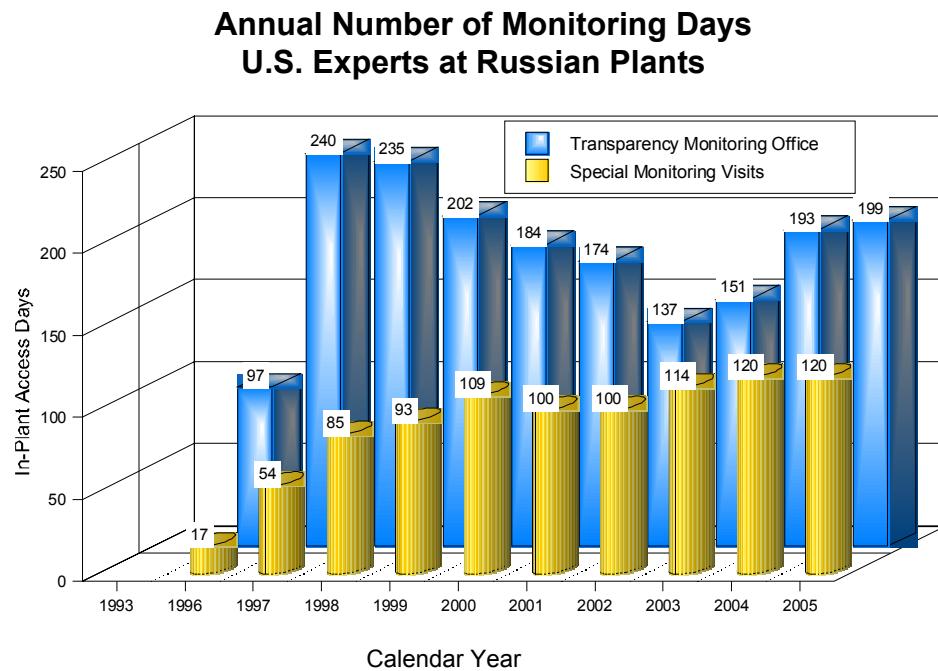
Additional BDMS units were installed at ECP in February 2003 and at SChE in October 2004.

Monitoring data and analysis are compared with Russian declared rates and inventories for consistency and accuracy.



Monitors at the Control Cabinets for the two BDMS units at UEIE

# HEU-TP Monitoring Trips In Russia



- In CY 2005 there were 24 Special Monitoring Visits (SMV) to four Russian processing plants and 12 monitors assigned to the Transparency Monitoring Office (TMO) at UEIE.
- From 1993 through 2005:
  - 184 SMV trips
  - 151 TMO monitor trips
  - 12 familiarization trips
  - 4 natural uranium inventory trips
- 24 SMV trips are scheduled for CY 2006.
- 14 TMO monitors are scheduled for CY 2006.
- Maximum coverage allows 24 SMV trips per year and a TMO staffed up to 12 months per year.

# HEU-TP Observations

## What is performed?

- Expert observation of process
- Tracking selected containers
- Compare observation and forms with process



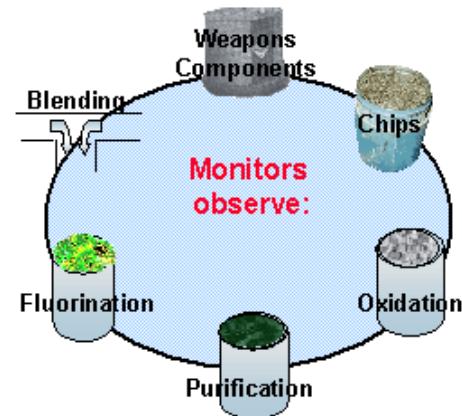
*30B cylinder (left) for LEU and cylinder overpack for transportation*

## What is observed?

- Process equipment used
- Process facilities and material
- Nuclear material accountability documentation

## Where?

- All four facilities



# HEU-TP Non-Destructive Assay (NDA) Testing



## What is used?

- Portable sodium iodide (NaI) based measurement equipment

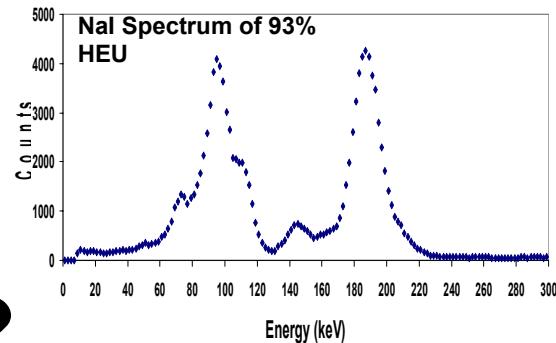


*Monitors using portable NDA testing equipment at MPA*



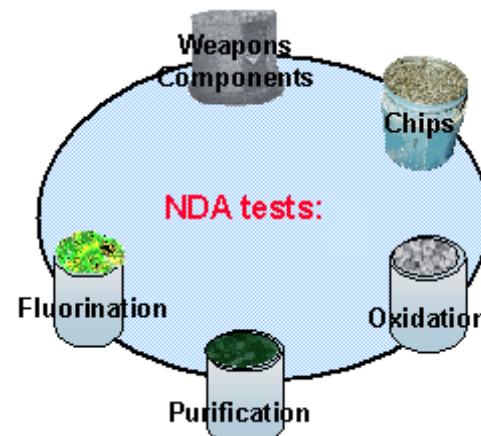
## What is measured?

- Assay of HEU in closed containers



## Where?

- All four facilities



# HEU-TP Tags and Seals

## What is used?

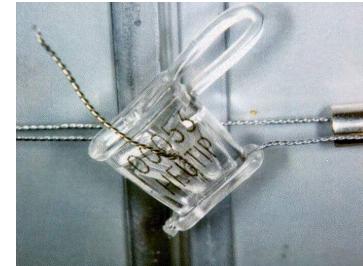
Mylar/tape seal



E-cup seal



Quickseal



## What is measured?

- Tamper indications for:
  - NDA units, BDMS
  - Transport of HEU container (*chain of custody*)
  - Orifice plates

## Where?

- All four facilities



# HEU-TP Blend Down Monitoring System (BDMS)



## What is performed?

- The system can confirm the traceability of HEU being blended into LEU.
- Confirm uranium flow and enrichment assay.
- It cannot determine HEU origin.

## What is measured?

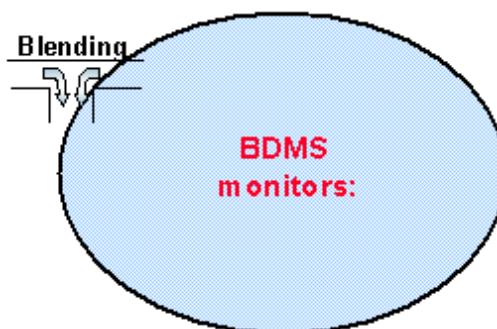
- Uranium assays
  - *HEU, LEU feed, & LEU product*
- Uranium flow rates
- Traceability: HEU to LEU

## Where?

- UEIE - Installed January 1999
- ECP - Installed February 2003
- SChE - Installed October 2004

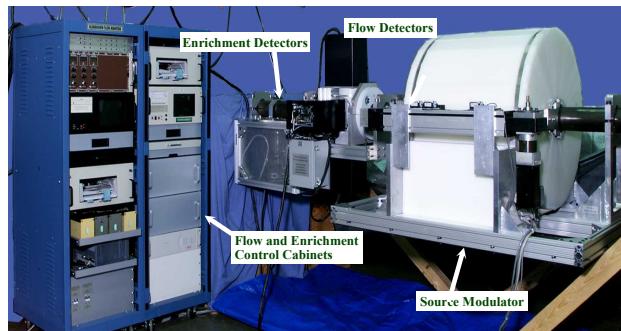
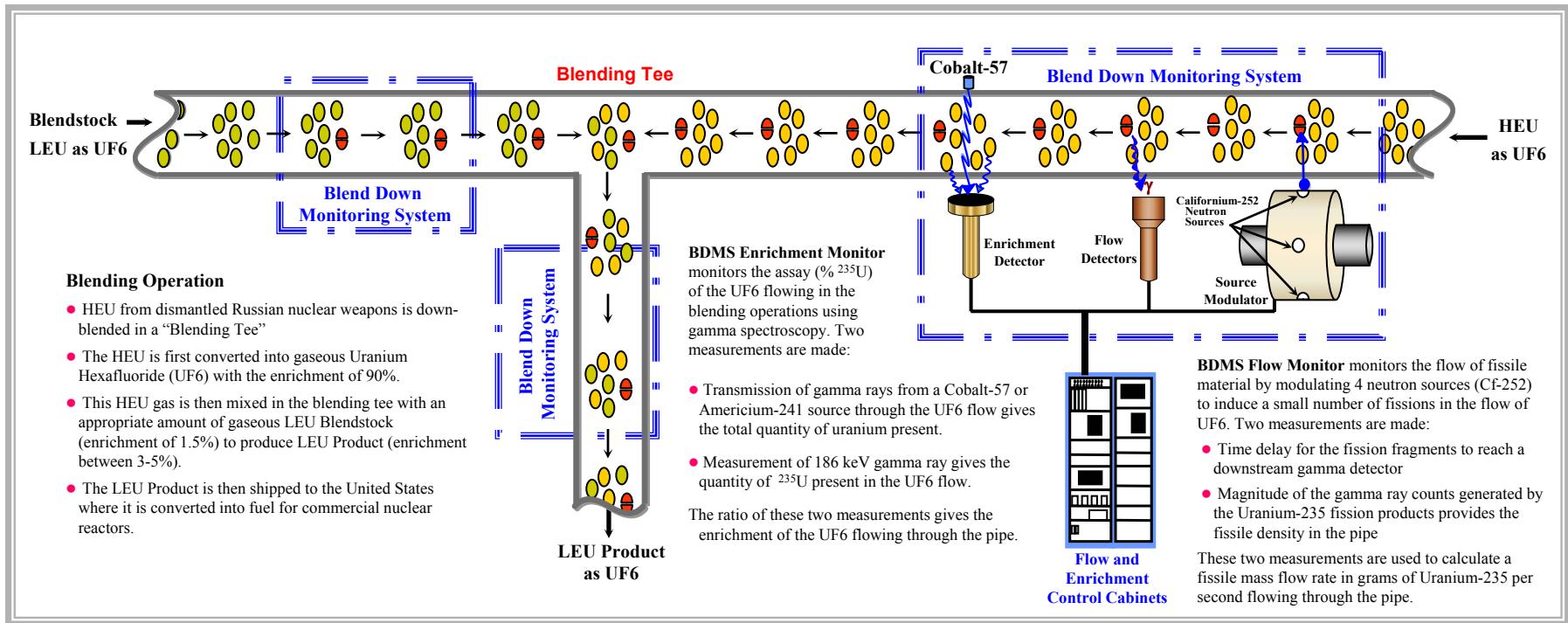


Monitors at ECP blend point with installed BDMS equipment



# Blend Down Monitoring System

*System designed in the USA and used in Russian Plants*



## Role of the BDMS in the HEU Transparency Program

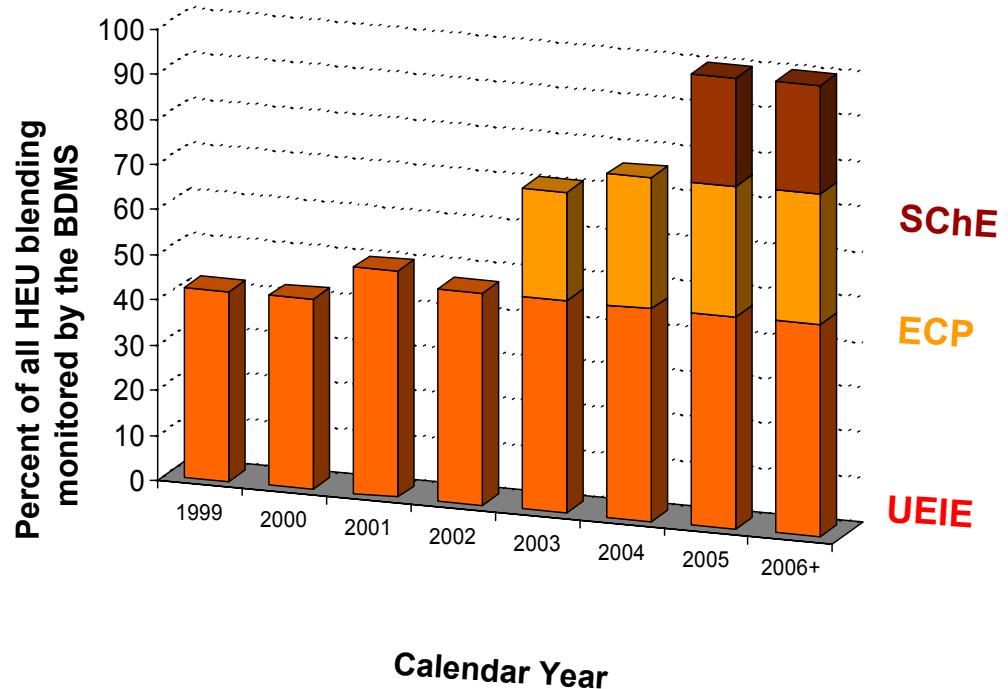
- The BDMS significantly increases confidence that HEU is blended into LEU Product by monitoring continuously the following items through the blending operations:
  - **Enrichment** assays:
    - Uranium Hexafluoride (UF6) in the HEU line
    - LEU Blendstock Line
    - LEU Product Line
  - **Mass flow** rate of fissile material
  - **Tracing** the flow of HEU

# The BDMS monitors blending of HEU at All Three Russian Blending Plants



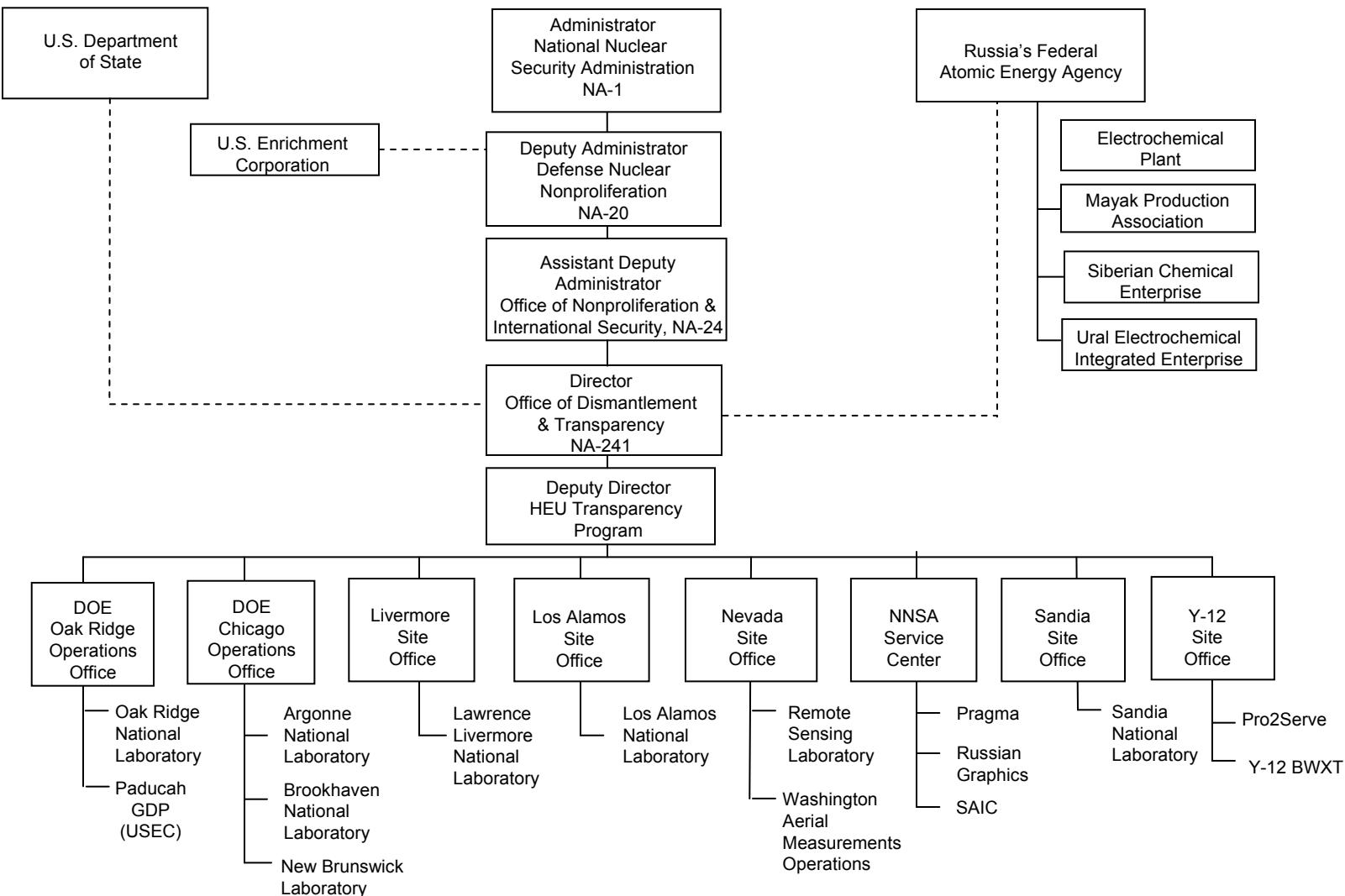
- The BDMS now provides 100 percent monitoring of HEU down blended into LEU at all three plants.
- Source changes are an ongoing operation.

- BDMS was installed at **UEIE** in **January 1999** and certified in August 1999.
- BDMS was installed at **ECP** in **February 2003** and certified in March 2003.
- BDMS was installed at **SChE** in **October 2004** and certified in February 2005.



Radioactive sources for the BDMS equipment are being supplied by the Russian Federal Nuclear Center-Institute of Technical Physics (Chelyabinsk-70)

# DOE/NNSA Organization and Coordination



# HEU-TP Accomplishments for Calendar Year 2005

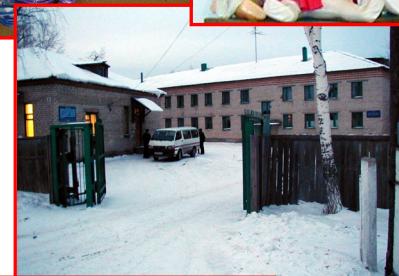


- Surpassed the 50% milestone in the amount of HEU downblended to LEU and delivered to the United States.
- Conducted 24 SMV trips to the four Russian HEU processing plants for a total of 120 days. (A total of 184 SMV trips were conducted from 1996 through the end of 2005.)
- Twelve TMO monitors staffed the TMO for a total of 199 days.
- Weighed and validated HEU content of 91% of the HEU cylinders received at UEIE, or about 40% of all HEU processed at the Russian plants.
- Performed about 3,900 measurements using portable NDA equipment to confirm the  $^{235}\text{U}$  enrichment in more than 3,200 Russian HEU containers and cylinders.
- Operated second-generation NDA units at all of the Russian sites.
- Monitored HEU blended down at UEIE, ECP, and SChE with the BDMS. Certification for operation of the BDMS at the SChE was completed in February 2005.
- Received, archived and processed 6500 pages of Russian facility process records and material control & accountability records.
- Operated a secure database and communications system connecting 13 sites in the United States, which centralizes and manages monitoring activities and data.
- Analyzed monitor observations and Russian declarations to build confidence in the achievement of our nonproliferation objectives.
- Coordinated Russian Transparency visit to 3 U.S. facilities in October 2005

# HEU Transparency Program Experts Visit Russian Children at Schools and Orphanages



Novouralsk  
School



Ozersk Orphanage



Zelenogorsk Orphanage



Through the generosity of HEU Transparency Program personnel, family and friends, over 500 children at six orphanages have benefited from personal donations of clothing, shoes, toys, educational and health-care supplies.

For further information contact:  
Janie B. Benton, Deputy Director for  
HEU Transparency Program  
Office of Dismantlement and Transparency  
National Nuclear Security Administration  
NA-241 / U.S. Department of Energy  
1000 Independence Avenue, SW  
Washington, D.C. 20585-1290  
Telephone: 202-586-5574  
Email: [Janie.Benton@nnsa.doe.gov](mailto:Janie.Benton@nnsa.doe.gov)